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**Adult and Juvenile Coho Salmon
Enumeration and Coded-wire Tag
Recovery Analysis for Zolzap Creek, BC,
1996**

B.L. Nass

Fisheries and Oceans Canada
Room 202, 417-2nd Ave.
Prince Rupert, BC
V8J 1G8

2001

**Canadian Manuscript Report of
Fisheries and Aquatic Sciences No. 2564**



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Canadian Manuscript Report of Fisheries and Aquatic Sciences

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Canadian Manuscript Report of
Fisheries and Aquatic Sciences 2564

2001

ADULT AND JUVENILE COHO SALMON ENUMERATION AND CODED-WIRE TAG
RECOVERY ANALYSIS FOR ZOLZAP CREEK, BC, 1996

prepared by

Bryan L. Nass

LGL Limited
environmental research associates¹

for the

Nisga'a Tribal Council²

¹ 9768 Second St., Sidney, BC V8L 3Y8

² P.O. Box 231, New Aiyansh, BC V0J 1A0

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Cat. No. Fs 99-4/2564E ISSN 0706-6473

Correct citation for this publication:

Nass, B.L. 2001. Adult and juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 1996. Can. Manuscr. Rep. Fish. Aquat. Sci. 2564: viii + 44 p.

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ABSTRACT

Nass, B.L. 2001. Adult and juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 1996. *Can. Manuscr. Rep. Fish. Aquat. Sci.* 2564: viii + 44 p.

Adult and juvenile coho migrations were monitored at Zolzap Creek, British Columbia, as part of the 1996-1997 Nisga'a Aboriginal Fisheries Strategy. The 1996 season is the fifth year of continuous operation of the Zolzap Creek fences since 1992. This report includes five year summaries of the most pertinent data. Smolt trapping was conducted from mid-April to mid-June using an instream wire-mesh fence. A total of 22,233 coho smolts were captured during the trapping period, and an unknown number migrated out during periods when the fence was not operational. Of those captured, 20,519 were released with coded-wire tags. Migration timing, mean length and weight at age, and age composition are presented.

Adult coho escapement was monitored using an instream fence and carcass surveys. The counting fence was operational between 5 September and 6 December. A total of 1,039 adult coho were counted at the fence. Adipose clip rate was 21.2% for adult coho. Age and length characteristics of adult males and females are presented.

Canadian and US commercial harvests were examined using coded-wire tag recovery data obtained from the Mark-Recovery Program. Total commercial exploitation rate on Zolzap Creek coho in 1996 was 60.5% (21.4% Canadian, 39.2% US). Of the total commercial catch of Zolzap Creek coho, Canadian catch accounted for 35.3% and the US catch accounted for an estimated 64.7%. Harvests occurred over a wide area ranging from Canadian Statistical Area 8 to the Northern Outside Statistical Area in Alaska (northwest of Juneau, AK). Canadian harvests were largest in Statistical Area 3 for both the net and troll fisheries. US harvests were confined entirely to Alaska with the largest in the Southern Outside Statistical Area for the net fishery and the Central Outside Statistical Area for the troll fishery. Total survival was 6.6% and smolt-to-spawner survival was 2.2%.

RÉSUMÉ

Nass, B.L. 2001. Adult and juvenile coho salmon enumeration and coded-wire tag recovery analysis for Zolzap Creek, BC, 1996. Can. Manuscr. Rep. Fish. Aquat. Sci. 2564: viii + 44 p.

Les migrations de saumons coho, adultes et jeunes, ont été mesurées au ruisseau Zolzap, en Colombie-Britannique, dans le cadre de la Stratégie des pêcheries autochtones des Niagas. De la mi-avril à la mi-juin, on a procédé à la capture de saumoneaux grâce à une barrière en toile métallique installée dans le cours d'eau. En tout, 22 233 saumoneaux coho ont été capturés pendant la période de piégeage, un nombre inconnu de poissons passant pendant les périodes où la barrière n'était pas opérationnelle. Sur l'ensemble des saumoneaux capturés, 20 519 ont été remis à l'eau avec une marque magnétique codée. La période de migration, la longueur moyenne, le poids et la composition selon l'âge sont présentés.

La remonte de saumons coho adultes a été surveillée grâce une barrière installée dans le cours d'eau et à l'observation des carcasses. La barrière de comptage était opérationnelle entre le 5 septembre et le 6 décembre. En tout, 1 039 saumons coho adultes ont été dénombrés à la barrière. Le taux d'ablation de la nageoire adipeuse était de 21,2 % pour les saumons coho adultes. On présente les caractéristiques d'âge et de longueur pour les mâles et les femelles adultes.

Les récoltes commerciales canadiennes et étatsuniennes ont été examinées grâce aux données de récupération des marques magnétiques codées provenant du Programme de marquage-récupération. Pour 1994, le taux d'exploitation commercial total de saumons coho au ruisseau Zolzap a été évalué à 60,5 % (21,4 % pour le Canada, 39,2 % pour les États-Unis). Sur le total de prises commerciales de saumon coho au ruisseau Zolzap, le Canada en comptait 35,3 % et les États-Unis 64,7 % (valeurs estimatives). Les récoltes couvraient un vaste secteur, s'étendant de la zone statistique canadienne 8 à la zone statistique extérieure nordique en Alaska (au nord-ouest de Juneau, en Alaska). Les récoltes canadiennes étaient les plus importantes dans la zone statistique 3, aussi bien pour la pêche au filet qu'à la traîne. Les récoltes étatsuniennes se limitaient entièrement à l'Alaska, les plus importantes se situant dans la zone statistique intérieure méridionale pour la pêche au filet, et dans la zone statistique extérieure centrale pour la pêche à la traîne. On estimait le taux de survie total à 6,6 %, et le taux de survie des saumoneaux par rapport au géniteurs à 2,2 %.

INTRODUCTION

As part of an agreement between the Nisga'a Tribal Council and the Canadian Government, an Interim Measures Program (IMP) was established for fisheries research in the Nisga'a Traditional Territory, British Columbia. One component of this large research initiative focused on the assessment of juvenile and adult coho populations in tributaries to the Nass River. Juvenile and adult coho enumeration studies have been conducted on Zolzap Creek since 1992 (Nass 1996a; Nass 1996b; Nass and English 1994; Nass 1996c; Nass 1997a; Nass 1997b). This report presents results for studies conducted at Zolzap Creek in 1996.

The objectives of the research were to:

1. Enumerate migrating juvenile coho and estimate escapement;
2. Document the timing, size, and age distribution of migrating coho;
3. Mark coho smolts with coded-wire tags (CWT) to enable the determination of oceanic harvest rates;
4. Monitor the escapement for marked (CWT) adult coho, and determine oceanic exploitation and survival rates; and
5. Collect data which will enable the future examination of the relationships between physical environmental factors and coho smolt migration timing, and between adult escapement and smolt production.

Achievement of these objectives involved the construction and operation of instream, semi-permanent, panel fences located approximately 0.5 km upstream of the mouth of Zolzap Creek.

STUDY STREAM

Zolzap Creek is a tributary to the Nass River, located in northwestern British Columbia (Fig. 1 and 2). Zolzap Creek flows for 6 km in a northwesterly direction between Nisga'a Lava Bed Memorial Park and the Kitimat Mountain Range to its confluence with the Nass River, 5 km downstream of Gitwinksihlkw. The main channel of the creek is regularly interrupted by beaver dams and log jams. The substrate is highly variable and ranges between silty particulate, to granite cobble, and coarse pumice. Major flow contributions come from Lava Creek (3 km in length) which flows from the lava beds and numerous small creeks that flow from the steep alpine. Intermittent flows of water from the Nass River and Vedder Creek are possible during flooding periods. The mouth of Zolzap Creek enters a side channel to the Nass River known as Zolzap Slough. The lower 0.5 km of Zolzap Creek regularly becomes inundated when water levels on the Nass River are high. Zolzap Creek supports many species of salmonids including coho (*Oncorhynchus kisutch*), pink (*O. gorbuscha*), chum (*O. keta*), sockeye (*O. nerka*), rainbow

(*O. mykiss*), cutthroat (*O. clarki*), and Dolly Varden (*Salvelinus malma*). Non-coho species include lampreys (family Petromyzontidae), sticklebacks (family Gasterosteidae), and sculpins (family Cottidae). Coho escapement was estimated to be 1,561 in 1992 (Nass 1996b); 1,048 in 1993 (Nass 1996c); 2,536 in 1994 (Nass 1997a); and 908 in 1995 (Nass 1997b).

JUVENILE COHO STUDIES

METHODS

Trapping Operations

An instream, semi-permanent enumeration fence was located 0.5 km upstream of the creek mouth for the capture of downstream migrating coho smolts. Fence design was based on Conlin and Tutty (1979) and minor modifications were made according to site characteristics and available materials. The fence was built in a W pattern and spanned the entire creek bed. Three by eight foot panels constructed of 2"x 4"s and covered with 1/4" wire-mesh were laid on their long side in the creek bed to form the fence. Rebar (3/8" and 1/2") rebar was used to anchor the panels to the stream bed. A second layer of panels was installed on top of the first row of panels to create a fence a total of six feet in height. Burlap sandbags and heavy duty garden sheeting were used to build a solid, fish-tight seal along the base of the panels. Two hinged panels were installed in each of the fence wings for emergency release of excess water head in the case of floods. Plywood trap boxes with Vexar-screened windows (to allow water exchange) were anchored at each downstream apex and connected to the fence via eight inch "Big O" tubing. Additional live boxes were used to hold fish after tagging and were designed with a small door to release the fish. A 2 m x 2 m fyke net was also used during flooding periods to assess downstream migration. The net was positioned in front of one apex of the fence. Provisions for upstream migrating adults were made by constructing a simple trap consisting of a wire-mesh panel extending out from the stream bank to one wing of the fence. Plywood was used to cover the adult trap area.

Separate trapping operations were conducted during the late summer to assess the size and age composition of juvenile coho rearing in the upper reaches of Zolzap Creek. Juveniles were captured during late August and early September using roe-baited gee traps. Biosampling data were collected to facilitate the assessment of system carrying capacity, potential overwintering survival, and to compare age compositions of rearing and smolting populations.

Physical Observations

Crews monitored water temperatures, water levels, and weather, daily. An electronic data logger (Unidata America, Lake Oswego, OR) was used to record daily maximum and minimum water temperatures and level. In addition, crews recorded temperature using a maximum-minimum thermometer and water level using staff gauges calibrated to the nearest 0.01 m. Water level gauges were located within 50 m of the trapping site (one upstream, one downstream of the

fence). Precipitation was recorded on a scale of 0 to 5, with 0 representing no precipitation and 5 being heavy precipitation.

Juvenile Enumerations

Daily numbers of coho smolts captured at the fence were obtained from the coded-wire tagging machine or counts conducted manually. Fence mortalities were added accordingly. Coho smolts were identified as juveniles greater than or equal to 70 mm in length. Coho smaller than 70 mm tended to be dark with distinct parr marks and lacking the silver colouration associated with smoltification. Therefore, this group consisted of pre-smolts and fry. All coho pre-smolts and fry, and non-coho species were counted and released downstream of the fence during sorting. Upstream migrating fish caught in the adult traps were counted and released upstream.

Biosampling

A random sample of up to 25 smolts (i.e., coho greater than or equal to 70 mm) were obtained from each day's catch. These smolts were anaesthetized and measured for fork length and weighed using an electronic scale (0.1 g). Scale sampling followed the stratified method of Ketchen, described by Ricker (1975). Age sample data (column X on Table 1) included non-random samples, and length sample data (column Y on Table 1) and the calculated age representation is based on random sampling. Crews attempted to collect at least 10 scale samples from each 5 mm size class of coho for the study period. Smolts of the required sizes were selected from the catch when the random sample did not provide the necessary sizes. Scale samples were interpreted by the Fisheries and Oceans Canada Scale Lab, Nanaimo, BC. Secondary quality control checks were performed to ensure a reliable age designation. Scale ages are reported in Gilbert-Rich notation where freshwater age 2 coho (i.e., having survived 2 winters from egg deposition) have a single freshwater annulus.

Biosampling was also conducted opportunistically on cutthroat and steelhead trout. Length, weight, scales and DNA tissue samples were obtained from adults and juveniles. No data or analysis is presented here, however, the data can be obtained from the author.

Coded-wire Tagging

Coded-wire tagging at Zolzap Creek was performed using a Mark IV tagging machine by Northwest Marine Technology Ltd. (Shaw Island, WA). An MS-222 bath was used to anaesthetize smolts prior to tagging. All tagged fish were adipose-fin clipped (AFC). Numbers of coho smolts tagged were recorded according to tag code. All tagged smolts were directed to a holding box in the stream and allowed to fully recover from the tagging operation before being released.

Tag retention tests were conducted for each tag code. A sample of tagged coho smolts (minimum of 200 smolts) was retained in a holding box for 24-h. Following the holding period, individual smolts from the holding box were slightly anaesthetized and passed through the coded-

wire tagging machines quality control device (QCD) to check for the presence of a coded-wire tag. Coho smolts not possessing a tag were checked a second time. The total number of tags detected was recorded from the CWT counter.

RESULTS

Physical Observations

Water temperatures during the smolt migration period at Zolzap Creek ranged from a minimum of 5.4° C in early April to a maximum of 11.3° C in mid-June (Fig. 3). Water level was steady from mid-April to the beginning of May when major flooding occurred. Zolzap Creek rose approximately 1.6 m from its minimum level. Water velocity decreased to a low rate and applied little pressure to the fence structure. Low velocity at high water levels is caused by the creek backing up when water levels of the Nass River are high.

Fish Enumerations

The Zolzap Creek juvenile counting fence was operated from 16 April to 20 June 1996. The fence was topped by water for the period 5 June to 7 June. The rotary trap was operated from 5 April to 24 June with only minor interruption in operation.

Trapping of summer juvenile coho in upper Zolzap Creek was conducted on 16 August, 24 August, and 5 September. All trapping occurred at the same location. A total of 810 juvenile coho were captured using 15 gee traps. Catch for individual traps ranged from 0 to 44 on soak times of 1 to 2 hours. Recaptures accounted for less than 10% of the total catch.

Coho Smolts: A total of 22,233 coho smolts were counted at the fence and rotary trap combined (Table 2, Fig. 4). The maximum number of smolts captured at the fence was 1,908 and occurred on 24 May (Table A-1). The maximum number of smolts captured at the rotary trap was 367 and occurred on 23 May. An unknown number of smolts moved past the trapping location during the three day flooding period in June. An additional 1,000 smolts were estimated to have left the system based on the pattern of migration. There were a total of 1,210 fry and pre-smolt coho counted and released during trapping operations (Table A-1).

Non-coho Species: Lampreys (larvae and young adults) were caught in the largest numbers followed by juvenile Dolly Varden (Table 3, Table B-1).

Biosampling: Length, Weight and Age

The mean fork length of age 2 smolts was 93.3 mm and the mean weight was 8.4 g (Table 1). Age 3 smolts averaged 110.4 mm and 13.2 g. Age 4 smolts ranged between 120 mm and 135 mm. The length-frequency distribution showed substantial overlap between age 2 and age 3 coho (Fig. 5). Age 2 smolts were most numerous in the 90-94 mm length class and age 3 smolts were most numerous in the 105-109 mm length class. Age 3 coho smolts were significantly larger than

age 2 smolts (t-test, $p < 0.0001$). Overall, coho smolts averaged 99.2 mm in length. The calculated freshwater age structure of coho smolts was 72.2% age 2, 27.1% age 3, and 0.7% age 4 (Table 1). A random sample of late summer juvenile coho were 99.5% age 1, and 0.5% age 2.

The mean fork length of age 1 summer juvenile coho was 50 mm and the mean weight was 1.6 g. The length-frequency distribution showed juveniles were most numerous in the 45-49 mm length class. Only one age 2 coho was sampled.

Coded-wire Tagging

Mean tag retention was 99.2% for tag code 18-20-52 and 100% for tag code 18-20-53 (Table 4). Crews conducted fourteen tests for tag code 18-20-52 for a total of 2,796 samples, and two tests on tag code 18-20-53 for a total of 400 samples.

Releases of AFC coho totalled 20,625 (Table 5; Table C-1). Crews recorded 201 mortalities associated with the tagging process. The total number of coho smolts released with coded-wire tags was 20,519. Less than 1% (120) of the captured coho smolts were released untagged during the study period. The total number of smolts released was 21,890.

ADULT COHO STUDIES

METHODS

Population Estimates

An aluminum conduit fence anchored to a crib-type sill was constructed at Zolzap Creek. All salmonids caught at the fence were counted and classified by sex. Sex was distinguished on the basis of length and body morphology. Previous studies at Zolzap Creek (Nass 1996b, 1996c, 1997a, 1997b) have shown an absence of jacks in the escapement; therefore, all males were classified as adults. "Jack panels" consisting of one inch wire mesh were used to prevent the passage of small coho through the fence and were used whenever water levels and debris permitted. Each coho was tagged on the operculum with a uniquely numbered Ketchum kurl-lock tag and measured for length. During handling, fish were examined for fin clips or tags that would be associated with coded-wire tagging or mark-recapture studies taking place on the Nass River. All captured fish were released upstream of the fence.

Live coho were recaptured in upstream surveys and checked for operculum tags (mark and recapture). Carcasses were recovered on the fence and during upstream surveys. In 1996, carcasses were recovered primarily in the lower 5 km of the creek.

Biosampling

All live coho captured at the fence were measured for postorbital-hypural length and examined for fin clips and sex. Adipose tissue was collected opportunistically for DNA analysis. Tissue samples were also collected from Tseax River coho during angling surveys. DNA samples were analysed at the Pacific Biological Station (T. Beacham, Fisheries and Oceans Canada, Nanaimo, BC). Sex ratios were calculated from total fence captures. Mean lengths were calculated for adult males and adult females. Crews attempted to sample at least 25 coho per day for scales (10 scales per fish). Scale samples were interpreted by the Fisheries and Oceans Canada Scale Lab, Nanaimo, BC. Secondary quality control checks were performed to ensure reliability of the age designations. Scale ages are reported in Gilbert-Rich notation where freshwater age 2 coho (i.e., having survived two winters from egg deposition) have a single freshwater annulus.

Adult returns (calculated by escapement method) and smolt production by CWT, and total populations were calculated for each brood year where data were available. Smolt output and adult escapement was apportioned between brood years (back-calculated) using the age structure observed in the respective yearly migrations. The sum of freshwater age 2, age 3, and age 4 individuals equals total production for a given brood year. Age composition for smolts and adults by brood year was calculated based on the estimated production. Total survival by brood year was calculated as the age-specific adult return divided by the respective smolt production. The smolt-to-spawner ratio for each brood year was calculated as the number of smolts produced divided by the number of adults in the respective escapement. Similarly, the recruit-to-spawner ratio for each brood year was calculated as the number of adults produced divided by the number of adults in the respective escapement.

Coded-wire Tag Recoveries

Coded-wire-tagged smolts were AFC prior to release for future identification in the fishery and the escapement. Coho smolts at Zolzap Creek were coded-wire-tagged (CWT) in the spring of 1995 (Nass 1997b) during their out-migration.

Escapement: Crews examined all coho captured at the fence for the presence or absence of the adipose fin. The contribution and survival of AFC coho to the escapement was determined using methods presented in Bocking et al. (1992) and modified in Nass (1997a). CWT heads were collected from sacrifices at the fence, the native net and angling fisheries, and through carcass recoveries. In addition, angling was conducted at nearby Spencer's Lake on the Tseax River to examine coho for fin clips. Separate CWT codes had been released in the Tseax as part of a small enhancement operation using Tseax origin broodstock (Alexander and Nass 1996). Nass (1997b) demonstrated straying from Zolzap to the Tseax and may contribute to the observed differences between mark rates at release and return at Zolzap.

Commercial and Sport Harvests: Commercial and sport catches of CWT fish are monitored by Fisheries and Oceans Canada and various US agencies, and are compiled in the

Mark Recovery Program (MRP). Data on CWT releases and recaptures are used to estimate the number of fish from a particular stock that have been harvested in the commercial and sport fishery, as well as determining the spatial and temporal distribution of harvests (Kuhn et al. 1988, Nass 1997a). The estimates include catch (observed catch corrected for sampling effort), expanded catch (estimated catch corrected for unmarked fish), exploitation rate (proportion of CWT coho caught in the fishery), and total return (expanded catch plus escapement).

Geographic Distribution of Harvest: Coded-wire-tagged fish in the commercial catch are recorded by Canadian and US fishery Statistical Areas. To estimate number of recoveries for each Canadian area, the observed CWT catch was expanded by the mean catch-sampling ratio observed in the Catch Region (e.g., Northern Troll = Statistical Areas 1, 3, 4, and 6). Similarly, US troll catch was expanded using the catch sampling ratio by quadrant (e.g., northwest) and the net catch sampling ratios, by district.

RESULTS

Physical Observations

During the period that the adult fence was operational, water temperatures ranged from a maximum of 10.7°C in late September to a minimum of 3.4°C in mid-November (Fig. 3). Water level rose a maximum of 0.8 m from its base flow during freshets (Fig. 3).

Adult Enumerations

The fence was operated continuously and fish tight from 31 August to 16 November. A total of 1,039 adult coho salmon were counted at the fence (Table 6). Of these, 1,007 adults were operculum tagged and released upstream. Maximum daily migration past the fence was 383 adults on 9 October (Table D-1), although there were three major pulses of coho past the fence during operation (Fig. 6). Crews examined a total of 64 live and dead adult coho collected on upstream surveys (fence to 5 km) and on the fence, respectively (Table 6). All but one coho had been tagged at the fence, therefore, no mark-recapture estimate was calculated. Upstream surveys were conducted on 5 September, 20 October, 11 and 25 November at upper Zolzap Creek; 18 and 30 October, 12 November at Goat Creek (a tributary); and 12 November at the "washed-out bridge" (3 km from fence) to collect CWT heads and assess opercular tag rates.

For non-coho species captured at the fence, pinks had the greatest abundance (72), followed by Dolly Varden (39), and chum (19) (Table 3). Cutthroat (18) and lamprey (16) were also captured at the fence. No sockeye or steelhead were observed in 1996. Chum and pink were caught in their greatest numbers in early September and their total numbers were up slightly from 1995. Trout were caught primarily in late September and mid-October and were less numerous than in 1995. No population estimates were derived for non-coho species.

Biosampling

A total of 102 coho were sampled for scales, of which 94 were successfully aged (Table 7). Unaged samples included marine regenerates. Adult males and females had different age compositions which averaged 58.1% and 49% freshwater age 2, and 41.9% and 51% freshwater age 3, respectively. The total age composition was 53.2% age 2, and 46.8% age 3. All aged scales were recorded as marine age 1 (i.e., having one marine annulus).

Mean lengths of adult males and females were 47 cm ($n=529$, $SD=8.3$) and 51.7 cm ($n=500$, $SD=4.5$), respectively. Adult male coho were widely distributed over the range of 23-67 cm with a mode of 50 cm (Fig. 7). Female coho had a mode of 52 cm with a range of 38-75 cm. For coho sexed during processing, adult males captured at the fence ($n=532$) were slightly more abundant than females ($n=503$). A total of 154 adipose tissue samples were collected at Zolzap Creek and 131 were collected at Tseax River.

Coded-wire Tag Recoveries

Escapement: Crews examined 1,030 adult coho for fin clips, of which 218 were AFC (21.2%; Table 8). An estimated 268 AFC adult coho returned to Zolzap Creek in 1996. Smolt to spawner survival (i.e., includes natural and harvest mortality) for adult coho was estimated at 2.2%.

Twenty-eight (28) CWT heads were collected at Zolzap Creek. Of these recoveries, 18 were from sacrifices at the fence, 7 were from carcass recoveries, and 3 were from the native angling fishery below the fence. Angling surveys at Tseax River examined 133 coho from which one CWT head was recovered (0.8%). Total tag retention was 100%. All the CWT recoveries at Zolzap Creek were from the 1995 release at Zolzap Creek (code 18-20-51). The single recovery at Tseax River was from the 1995 release at Tseax River (code 18-20-50).

Commercial and Sport Harvests: Total observed Zolzap Creek coho CWT recoveries were 33 and 99 for Canadian and US (Alaska) fisheries, respectively (Table 9). Observed sport recoveries totalled five for the US fisheries. All CWT recoveries were from the 1995 release year. Northern Canadian troll and net catch-to-sample ratios were 5.3 and 2.5, respectively, while US troll and net ratios were 2.8 and 3.1, respectively (Table 9). Estimated Zolzap Creek CWT coho catches were 144 and 307 for Canadian and US fisheries, respectively (Table 9).

Expanded Canadian and US catches were 175 and 374, respectively, for a total of 549 using the CWT mark ratio at release (i.e., MRP method) (Table 10). Expanded Canadian and US catches were 677 and 1,443, respectively, for a total of 2,120 using the adipose-clip ratio at recovery (i.e., escapement method). Estimated total adult return for Zolzap Creek coho was 817 and 3,159 using the MRP and escapement methods, respectively (Table 10).

Of the total commercial catch of Zolzap Creek coho, Canadian fisheries accounted for 35.3% and the US accounted for 64.7% (Table 11). Canadian troll and net fisheries accounted for

81.3% and 18.8% of the total Canadian catch, respectively. US troll and net fisheries accounted for 79.2% and 20.8% of the total US catch, respectively. Commercial harvest of Zolzap Creek coho occurred over a wide area ranging from Canadian Statistical Area 8 to the US Northern Outside Statistical Area in Alaska (Table 11, Fig. 8). Canadian harvests were largest in Statistical Area 3 for both the net (4.4%) and troll fisheries (17.4%). US harvests were largest in the Southern Outside Statistical Area for the net fishery (7.1%) and the Central Outside Statistical Area for the troll fishery (24%).

Total commercial exploitation rate (Canadian and US combined) on Zolzap Creek coho was 60.5%. Total Canadian exploitation rate was 21.4% (17.4% troll, 4% net) and total US exploitation rate was 39.2% (31% troll, 8.2% net). Total survival was 6.6%.

DISCUSSION

Over the past 5 years of monitoring, the average number of smolts estimated leaving Zolzap Creek was 36,200 (Table 12). On average, the smolt population was comprised of 56.3% age 2 and 42.1% age 3.

Adult coho counted at the fence in 1996 totalled 1,039. After CWT sacrifices ($n=20$), escapement was 1,019 plus an undetermined number of coho that spawned below the fence. The native and sport fisheries harvested an unknown number of coho below the fence. Average escapement for 1992-1996 was 1,418 (Table 12).

Data from 1992-1995 have indicated that there are no jacks in the Zolzap Creek escapement (Nass 1996b, 1996c, 1997a, 1997b). In 1996, CWT and scale ageing data have again confirmed the absence of jacks in the population. More specifically, CWT's were decoded from 28 heads taken from coho that measured between 23 and 61 cm (post-orbital-hypural) and found all to be from 1995 releases. Thirteen of the samples were from coho measuring less than 35 cm. This length has been used in previous studies at other British Columbia streams to designate jacks in the escapement and is based on CWT analysis. The results of this CWT analysis agree with scale ageing which indicated all samples ($n=3$) were of marine age 1.

In Alaska, comprehensive information exists for several southeast stocks, including Hugh Smith Lake (Southern Inside Statistical Area, see Fig. 8), which has been monitored since 1982. Preliminary data for the 1996 return suggests exploitation rates of 4.1% Canadian and 71.6% US (75.7% total; Leon Shaul, Alaska Dept. of Fish and Game, Douglas, AK, pers. comm.). Southeast Alaska and Canadian fisheries accounted for approximately 94.5% and 5.5% of the commercial catch of Hugh Smith coho, respectively. The total exploitation rate on Hugh Smith coho was moderately higher than exploitation rates of 21.4% Canadian and 39.2% US (60.5% total) on Zolzap Creek coho in 1996. Preliminary CWT data for the 1996 return of Hugh Smith coho suggest a survival rate of 17.9% which is substantially higher than for Zolzap Creek coho at 6.6%. Hugh Smith coho have had substantially higher survivals (1995: 13.7%, 1994: 19.4%, 1993: 13%) compared to Zolzap coho (1995: 3.6%, 1994: 8.9%, 1993: 2.1%) in the past three years.

Zolzap Creek CWT coho have been subjected to total exploitation rates between 60% and 72% and have had total survival rates between 2.1% and 8.9% over the period 1993 to 1996 (Table 12). Canadian fisheries have had exploitation rates between 12.9% and 21.4% on Zolzap CWT coho, while US fisheries ranged between 39.2% and 54.8%. Of the total commercial and sport catch of Zolzap Creek coho, Canadian fisheries have averaged 26.2% and the US has averaged 73.9% over four years. Adult returns averaged 4,673 for the brood years 1990 to 1993.

Total smolt production by brood year averaged 42,259 (1990-1992) and was composed primarily of age 2 fish (62.7%, Table 13). Adult production by brood year averaged 5,277 (1990-1992) and was 50.9% age 2 fish. Age composition at return was substantially different from that observed in the respective smolt populations and varied widely. Age 4 fish were absent from all adult escapements. Total survival by brood year of all Zolzap coho (unmarked + CWT) averaged 13.3% (1990-1992, Table 13). Total survival of Zolzap CWT coho was substantially lower at 5.2%. The number of smolts per spawner was 11.1 and 12.8 for the brood years 1992 and 1993, respectively, and the number of recruits per spawner was 1.8 for the 1992 brood.

ACKNOWLEDGMENTS

The cooperation of many people was essential in meeting the objectives of this study. Special thanks go to Leonard Squires for monitoring all aspects of operations as crew supervisor. Peter "Normy" Squires, Tim Angus, Kevin Small, Todd Ducharme, and Jim Ferguson assisted in constructing and operating the fence. Michael Link provided logistical support and reviewed the manuscript. Karl English provided technical support. Doug Herriot of the Department of Fisheries and Oceans provided the CWT catch data from the Mark Recovery Program. Robin Tamasi provided mapping support. Funding for this project was provided by the Canadian government as part of the Nisga'a - Canada (Aboriginal Fisheries Strategy) Contribution Agreement (CA96-139).

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TABLES

Table 1. Age-length distribution of Zolzap Creek coho smolts, 1996.

Size-Class (mm)	Age Sample (X)	Age-groups in X			Length Sample (Y)	Calculated Age Representation in Y		
		2	3	4		2	3	4
70	15	15	0	0	15	15.0	0.0	0.0
75	38	36	2	0	41	38.8	2.2	0.0
80	57	57	0	0	64	64.0	0.0	0.0
85	121	119	2	0	128	125.9	2.1	0.0
90	152	141	11	0	180	167.0	13.0	0.0
95	146	118	28	0	164	132.5	31.5	0.0
100	99	65	34	0	121	79.4	41.6	0.0
105	84	41	43	0	99	48.3	50.7	0.0
110	36	14	22	0	53	20.6	32.4	0.0
115	26	11	15	0	37	15.7	21.3	0.0
120	35	12	19	4	46	15.8	25.0	5.3
125	13	2	11	0	21	3.2	17.8	0.0
130	12	2	10	0	20	3.3	16.7	0.0
135	6	0	5	1	13	0.0	10.8	2.2
140	2	0	2	0	3	0.0	3.0	0.0
145	2	0	2	0	2	0.0	2.0	0.0
150	0	0	0	0	0	0.0	0.0	0.0
155	0	0	0	0	0	0.0	0.0	0.0
160	1	0	1	0	2	0.0	2.0	0.0
165	0	0	0	0	1	0.0	1.0	0.0
170	0	0	0	0	0	0.0	0.0	0.0
175	0	0	0	0	0	0.0	0.0	0.0
180	0	0	0	0	0	0.0	0.0	0.0
185	1	0	1	0	1	0.0	1.0	0.0
Mean length	97.7	93.3	110.4	125.4	99.2			
SD	13.7	10.4	14.1	7.8	14.6			
Mean weight (g)	9.7	8.4	13.2	17.7	10.2			
SD	4.1	2.9	4.8	4.3	4.6			
Total samples	846	633	208	5	1011	730	274	7
% contribution		74.8	24.6	0.6		72.2	27.1	0.7

Table 2. Coho smolt catch at Zolzap Creek enumeration fence and rotary trap, by week, 1996.

Week ending	Fence	Rotary	Total
6-Apr		4	4
13-Apr		10	10
20-Apr	199	5	204
27-Apr	184	5	189
4-May	214	22	236
11-May	1262	83	1345
18-May	4148	371	4519
25-May	6494	1102	7596
1-Jun	3890	327	4217
8-Jun	1476	46	1522
15-Jun	1725	96	1821
22-Jun	518	51	569
29-Jun	0	1	1
Totals	20,110	2,123	22,233

Table 3. Non-coho catch at the spring juvenile and fall adult fences at Zolzap Creek, 1992-1996 ^a.

Species	Time/lifestage	1992	1993	1994	1995	1996	Avg.
Pink	Fall Adult	115	149	251	52	72	128
Chum	Fall Adult	30	111	68	8	19	47
Sockeye	Spring Juvenile	4	244	328	189	119	177
	Fall Adult	4	11	28	7	0	10
Cutthroat	Spring Juvenile	12	69	36	67	121	61
	Spring Adult	308	278	224	43	55	182
	Fall Adult	17	27	14	28	18	21
Dolly Varden	Spring Juvenile	682	309	339	518	711	512
	Spring Adult	644	728	1529	28	44	595
	Fall Adult	9	21	10	81	39	32
Steelhead	Spring Juvenile	11	15	36	12	30	21
	Spring Adult	33	0	5	0	0	8
	Fall Adult	5	0	2	0	0	1
Lamprey ^b	Spring Juvenile	749	906	1277	2314	1333	1316
	Spring Adult	-	-	-	-	28	28
	Fall Adult	-	-	-	2	16	9

^a Trapping effort not equal between years.^b Adults and juveniles not distinguished for period 1992 - 1995.

Table 4. Coded-wire tag retention rates for Zolzap Creek coho smolts, 1996.

Sampling date	Tagging date	Tag code	Hours held	Sample size	No. tags lost	Percent retention
9-May	8-May	18-20-52	24	200	3	98.5
11-May	9-May	18-20-52	48	196	0	100.0
13-May	11-May	18-20-52	48	200	0	100.0
15-May	14-May	18-20-52	24	200	0	100.0
16-May	15-May	18-20-52	24	200	1	99.5
17-May	16-May	18-20-52	24	200	0	100.0
18-May	17-May	18-20-52	24	200	0	100.0
19-May	18-May	18-20-52	24	200	0	100.0
20-May	19-May	18-20-52	24	200	4	98.0
21-May	20-May	18-20-52	24	200	1	99.5
22-May	21-May	18-20-52	24	200	1	99.5
23-May	22-May	18-20-52	24	200	7	96.5
24-May	23-May	18-20-52	24	200	4	98.0
29-May	28-May	18-20-52	24	200	0	100.0
Subtotal				2796	21	99.2
30-May	29-May	18-20-53	24	200	0	100.0
31-May	30-May	18-20-53	24	200	0	100.0
Total				400	0	100.0

Table 5. Coded-wire tagged coho smolt releases from Zolzap Creek, 1996.

Tag code	Tagging dates	No. AFC	Tag No. released morts	AFC	No. tagged ^a	AFC only ^b	No. released untagged ^c	Total release ^d	CWT mark rate ^e
18-20-52	3 Apr - 23 May	10,779	133	10,646	10,540	106	821	11,467	1.09
18-20-53	24 May - 24 Jun	10,047	68	9,979	9,979	0	444	10,423	1.04
Total		20,826	201	20,625	20,519	106	1,265	21,890	1.07

^a No. tagged (corrected for tag loss) = No. released AFC - (No. released AFC * No. lost tags / No. sampled); see Table 4.

^b No. AFC only = No. released AFC - No. tagged

^c No. released untagged = the number of unmarked fish released which belong to the same group as the tagged and AFC only fish.

^d Total release = No. tagged + AFC only + untagged

^e CWT mark rate = Total release / No. tagged

Table 6. Adult coho enumerations and recoveries at Zolzap Creek fence, 1996.

Item	No. of adults
Number live coho captured at fence	1,039
Number of live coho released untagged	12
Number of coho sacrificed at the fence	20
Number live coho operculum tagged	1,007
Number coho recovered (live + dead)	64
Number of coho recovered untagged (live + dead)	1
Number of coho recovered with lost tags (live + dead)	1

Table 7. Freshwater age distribution of adult coho at Zolzap Creek, 1996.

Sex	Age 2		Age 3		Total aged	Total unaged	Total sampled
	No.	%	No.	%			
Adult males	25	58.1	18	41.9	43	3	46
Adult females	25	49.0	26	51.0	51	5	56
Total adults	50	53.2	44	46.8	94	8	102

Table 8. Estimates of total escapement of adipose clipped coho and contribution to escapement at Zolzap Creek, 1993-1996.

Year	No. examined	No. with adipose clips		% AFC (C=B/Ax100)	Population estimate		% sampled (E=A/Dx100)	Estimated adipose clips		No. smolts ^a		Contribution to escap. ^b	Smolt to spawner (%) ^c
		(A)	(B)		(D)	(F=B/AxD)		AFC	unclipped ^a	% AFC			
1993	784	191	24.4	1,048	74.8	255	33,923	6,678	83.6	306	0.8		
1994	2,416	499	20.7	2,536	95.3	524	22,986	3,348	87.3	600	2.3		
1995	906	308	34.0	908	99.8	309	29,615	4,804	86.0	359	1.0		
1996	1,030	218	21.2	1,039	99.1	220	10,166	2,203	82.2	268	2.2		
Avg.	1,284	304	25.0	1,383	92.2	327	24,173	4,258	84.8	383	1.6		

^a smolt releases of the previous migration year, an unknown number of additional unclipped releases were likely.

^b marked contribution to escapement = estimated adipose clips * (clipped + unclipped) / clipped

^c % survival = estimated AFC + AFC below the fence / AFC smolts * 100

Table 9. Estimated Canadian and American commercial and sport harvest of Zolzap Creek CWT coho in 1996 using tag recovery data (Mark Recovery Program, Fisheries and Oceans, Canada).

Tag code	Observed CWT catch ^a				Catch-sample ratio ^b			Estimated CWT catch ^c			
	N. Troll	N. Net	Sport	Total	N. Troll	N. Net	Sport	N. Troll	N. Net	Sport	Total
<u>Canadian</u>											
18-20-51	22	11	0	33	5.3	2.5	0.0	117	27	0	144
<u>American</u>											
18-20-51	76	18	5	99	2.8	3.1	8.6	209	55	43	307
<u>Total</u>	98	29	5	132	3.3	2.8	8.6	326	82	43	451
Total commercial											408
Total sport											43
Total native fishery ^d											3
Total escapement ^e											220
Total CWT											674

^a Observed CWT = CWT's recovered from the commercial and sport catch

^b Cumulative catch-sample ratio = total coho catch / total coho sampled

^c Estimated CWT = observed CWT catch * catch sampling ratio

^d observed harvest

^e Estimated CWT's (adipose clips corrected for tag loss at return); see Table 8

Table 10. Expanded Canadian and American commercial and sport harvest of Zolzap Creek coho and estimated total return, 1996.

Tag code	Total release	Smolts tagged ^a	Mark rate ^b	Expanded catch ^c								Contri- bution Total escap. return ^d		
				Canadian			American							
				Troll	Net	Sport	Total	Troll	Net	Sport	Total			
18-20-5	12,369	10,156	1.22	142	33	0	175	255	67	52	374	549		
Total 1 ^e			1.22	142	33	0	175	255	67	52	374	549	268	817
Total 2 ^f			4.70	550	127	0	677	982	259	202	1443	2120	1,039	3,159

^a Number smolts released with tags (corrected for tag loss), Nass (1997b).

^b Mark rate at release (= No. released / No. marked) for smolts and Total 1 (MRP method), and mark rate at return for Total 2 (Escapement method).

^c Expanded catch = EST * mark rate at release

^d Total return = expanded catch + escapement

^e Total 1 expanded catch is calculated using the total mark rate at release and the total estimated catch for all tag codes (Table 9).

^f Total 2 expanded catch is calculated using the total adipose clip rate at recovery and the total estimated catch for all tag codes (Table 9).

Table 11. Estimated commercial harvest distribution of Zolzap Creek CWT coho by area and gear type, 1996. Percentage is of total commercial harvest (does not include sport recoveries).

Area ^a	Net	%	Troll	%	Total	%
<u>Canada</u>						
1	0	0.0	41	10.0	41	10.0
3	18	4.4	71	17.4	89	21.8
4	5	1.2	5	1.2	10	2.5
8	4	1.0	0	0.0	4	1.0
subtotal	27	6.6	117	28.7	144	35.3
<u>U.S.A. (Alaska)</u>						
Northern Outside	0	0.0	20	4.9	20	4.9
Central Outside	0	0.0	98	24.0	98	24.0
Southern Outside	29	7.1	44	10.8	73	17.9
Southern Inside	21	5.1	38	9.3	59	14.5
Central Inside	0	0.0	0	0.0	0	0.0
Southern Intermediat	0	0.0	6	1.5	6	1.5
Stephen Passage	0	0.0	0	0.0	0	0.0
Lynn Canal	5	1.2	0	0.0	5	1.2
Central Intermediate	0	0.0	3	0.7	3	0.7
subtotal	55	13.5	209	51.2	264	64.7
TOTAL	82	20.1	326	79.9	408	100.0

^a includes respective sub-areas

Table 12. Adult and juvenile coho enumeration and age composition, and exploitation and survival at Zolzap Creek, 1992-1996.

Migration Year	Smolt Out-migration				Adult Escapement				Can		US		Total		
	Count	Estimate	CWT	% Age2	% Age3	% Age4	Count	Estimate	Return	% Age2	% Age3	%Exp.	% Cat.	%Exp.	%Surv.
1992	40,601	53,000	33,150	54.3	45.7	0.0	691	1,561	-	79.0	21.0	-	-	-	-
1993	26,334	51,000	22,649	67.9	32.1	0.0	794	1,048	2,832	58.3	41.7	15.5	24.6	47.5	63.0
1994	34,419	41,000	29,319	29.8	69.5	0.7	2,438	2,536	9,645	60.4	39.6	18.6	25.7	53.7	72.3
1995	12,369	13,000	10,156	55.1	37.9	7.0	908	908	3,057	41.3	58.7	12.9	19.0	54.8	67.7
1996	20,745	23,000	20,519	72.2	27.1	0.7	1,039	1,039	3,159	53.2	46.8	21.4	35.3	39.2	60.5
Average	26,894	36,200	23,159	55.9	42.5	1.7	1,174	1,418	4,673	58.4	41.6	17.1	26.2	48.8	65.9
															5.3

Table 13. Adult and juvenile coho production and age composition by brood year, Zolzap Creek, 1990-1994^a.

CWTs

Brood Year	Smolt Production			Adult Returns			Smolts			Adults			% Total Survival		
	Age 2	Age 3	Age 4	Total	Age 2	Age 3	% Age 2	% Age 3	% Age 4	% Age 2	% Age 3	% Age 4	Age 2	Age 3	Age 4
1990	18,000	7,270	205	25,476	402	802	70.7	28.5	0.8	33.4	66.6	0.8	2.2	11.0	0.0
1991	15,379	20,377	711	36,466	1,223	628	42.2	55.9	1.9	66.1	33.9	1.9	8.0	3.1	0.0
1992	8,737	3,849	144	12,730	441	315	68.6	30.2	1.1	58.3	41.7	1.1	5.1	8.2	0.0
1993	5,596	5,561	-	11,157	359	-	50.2	49.8	-	100.0	-	-	6.4	-	-
1994	14,815	-	-	14,815	-	-	100.0	-	-	-	-	-	-	-	-
Avg. ^b	12,505	9,264	353	24,891	606	582	60.5	38.2	1.3	52.6	47.4	1.3	5.4	7.4	0.0

All fish

Brood Year	Smolt Production			Adult Returns			Smolts			Adults			% Total Survival		
	Age 2	Age 3	Age 4	Total	Age 2	Age 3	% Age 2	% Age 3	% Age 4	% Age 2	% Age 3	% Age 4	Age 2	Age 3	Age 4
1990	28,779	16,371	287	45,437	1,651	3,819	63.3	36.0	0.6	30.2	69.8	0.6	5.7	23.3	0.0
1991	34,629	28,495	910	64,034	5,826	1,794	54.1	44.5	1.4	76.5	23.5	1.4	16.8	6.3	0.0
1992	12,218	4,927	161	17,306	1,263	1,478	70.6	28.5	0.9	46.1	53.9	0.9	10.3	30.0	0.0
1993	7,163	6,233	-	13,396	1,681	-	53.5	46.5	-	100.0	-	-	23.5	-	-
1994	16,606	-	-	16,606	-	-	100.0	-	-	-	-	-	-	-	-
Avg. ^b	19,879	14,007	453	42,259	2,605	2,364	62.7	36.3	1.0	50.9	49.1	1.0	14.1	19.9	0.0

^a (-) Incomplete data for 1993 and 1994 - to be completed with data from subsequent returns.

^b average for "Total" includes years for which complete production data is available.

FIGURES

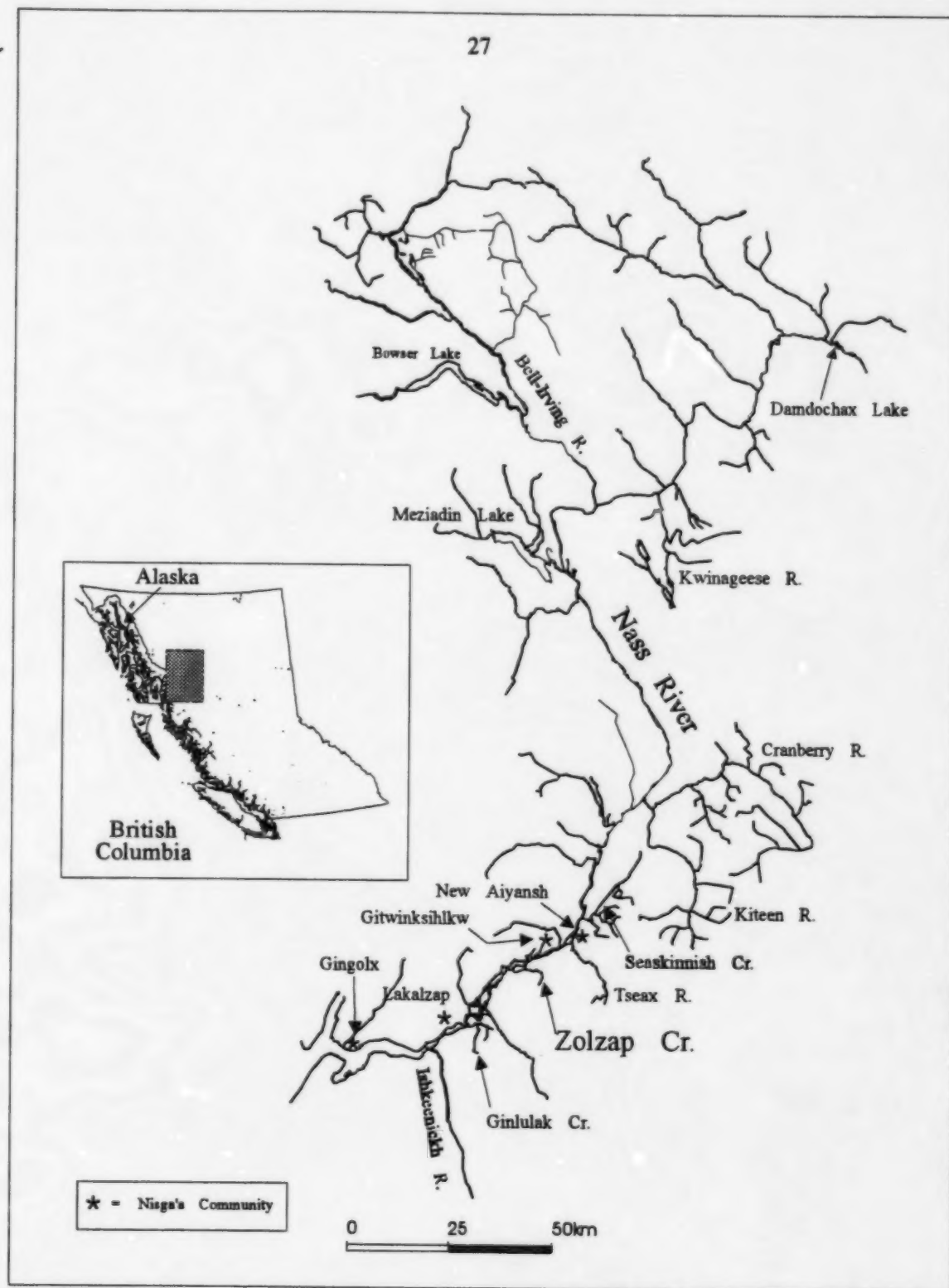


Figure 1. The Nass River watershed, British Columbia.

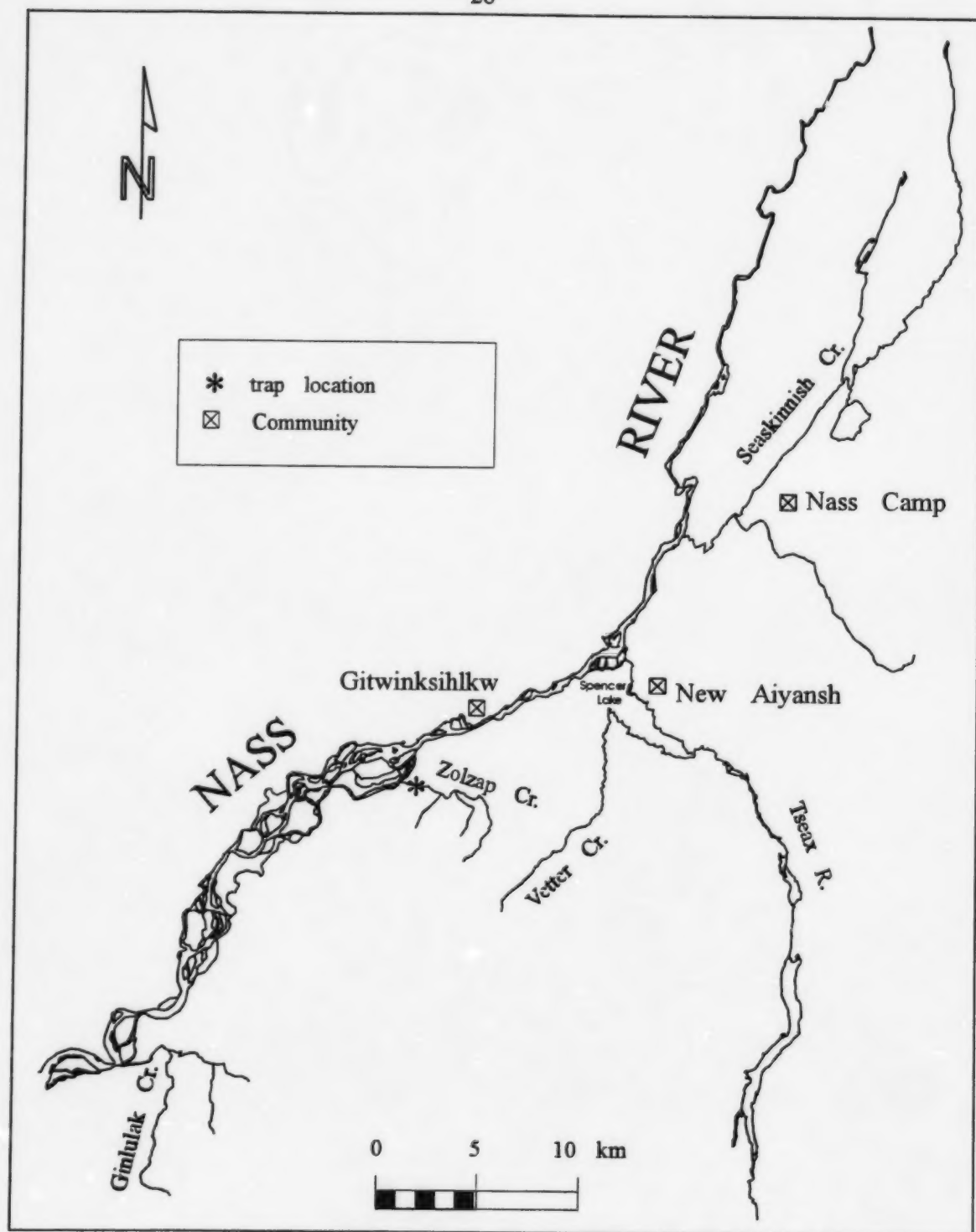


Figure 2. Zolzap Creek and location of enumeration fence.

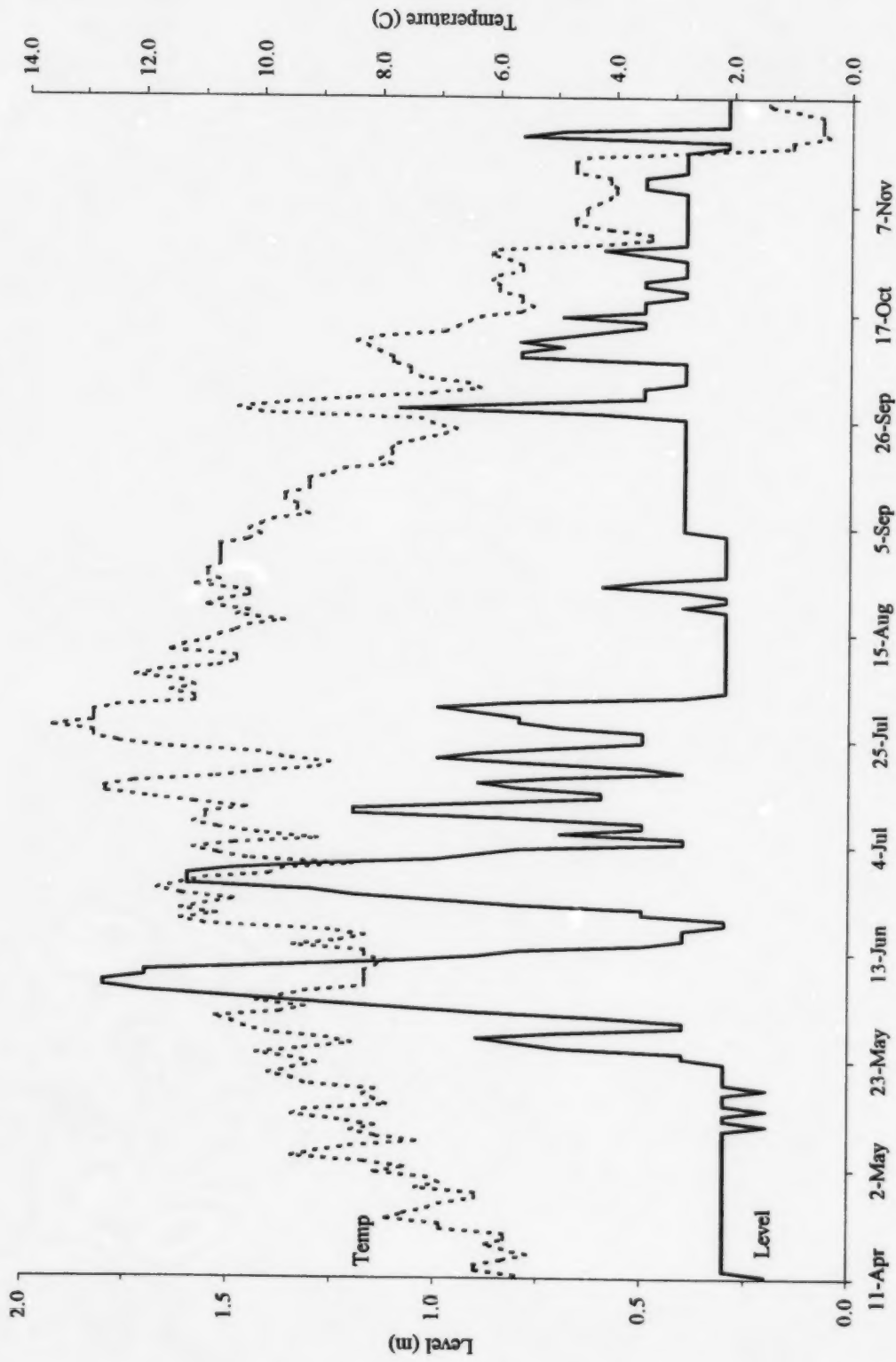


Figure 3. Water level and temperature at Zolzap Creek, 1996.

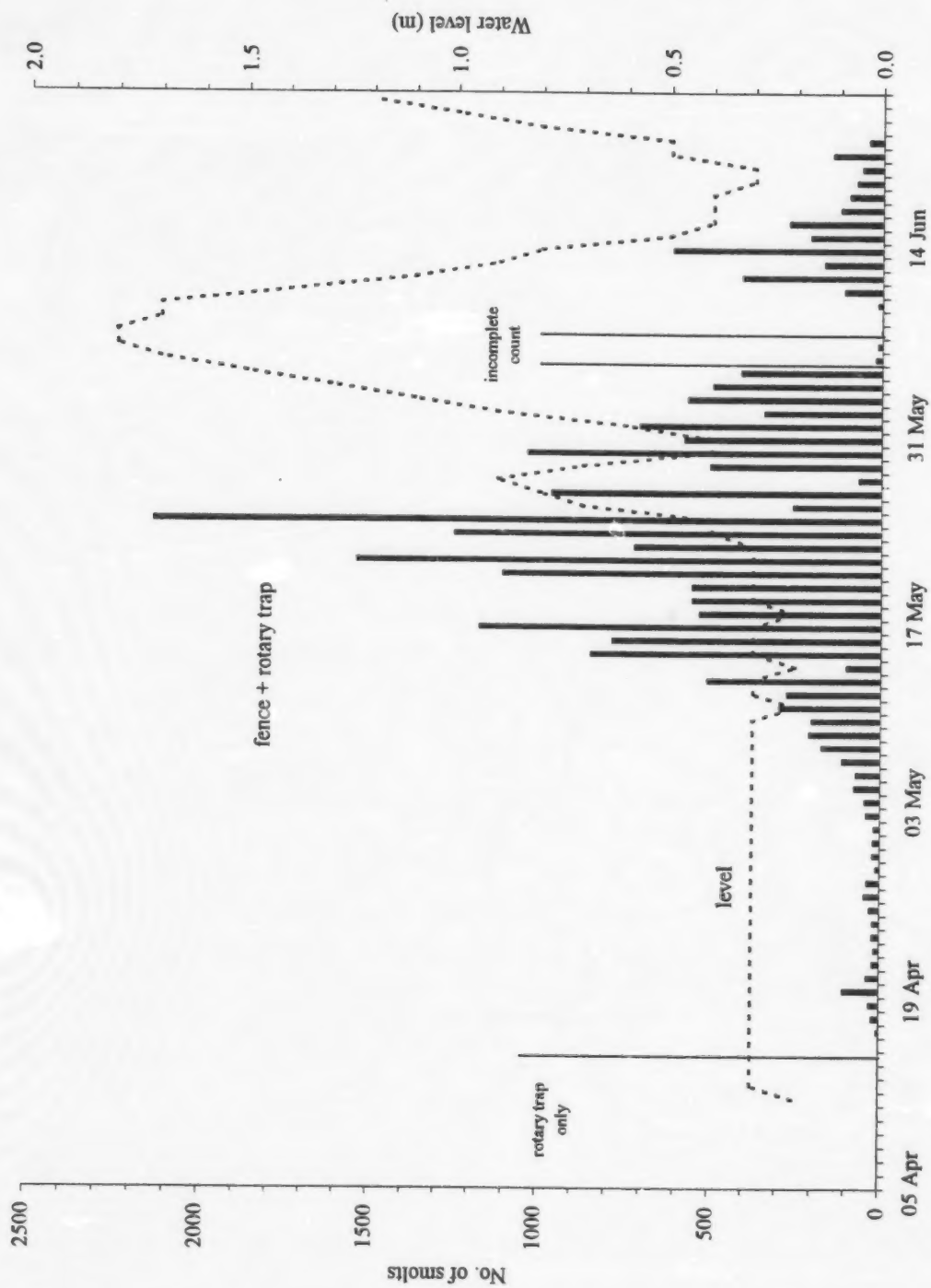


Figure 4. Daily migration of coho smolts at Zolzap Creek, 1996.

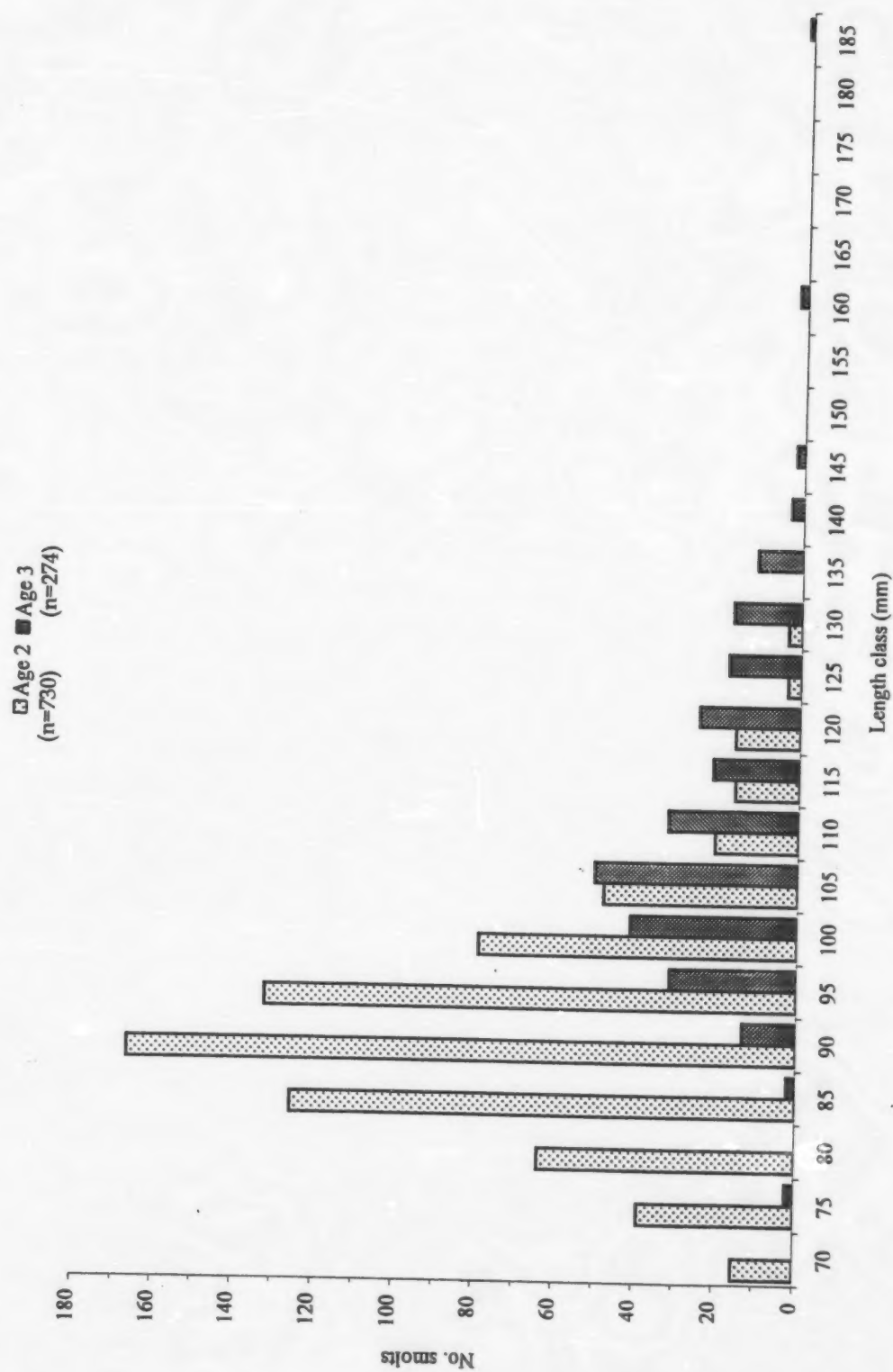


Figure 5. Length-frequency and calculated age distribution of Zolzap Creek coho smolts, 1996. Age 4 samples are excluded for clarity (see Table 3).

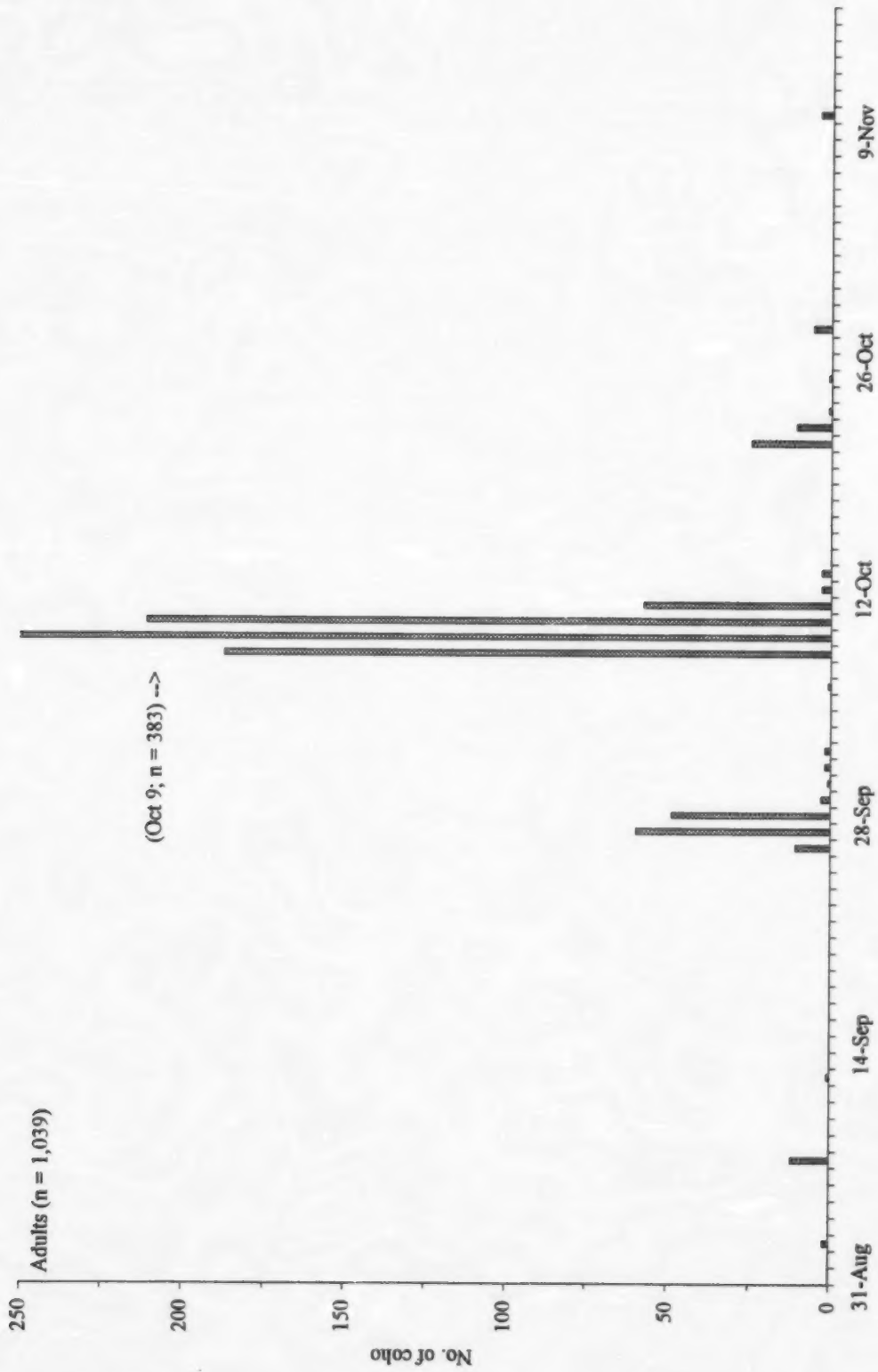


Figure 6. Daily counts of adult coho at the Zolzap Creek enumeration fence, 1996.

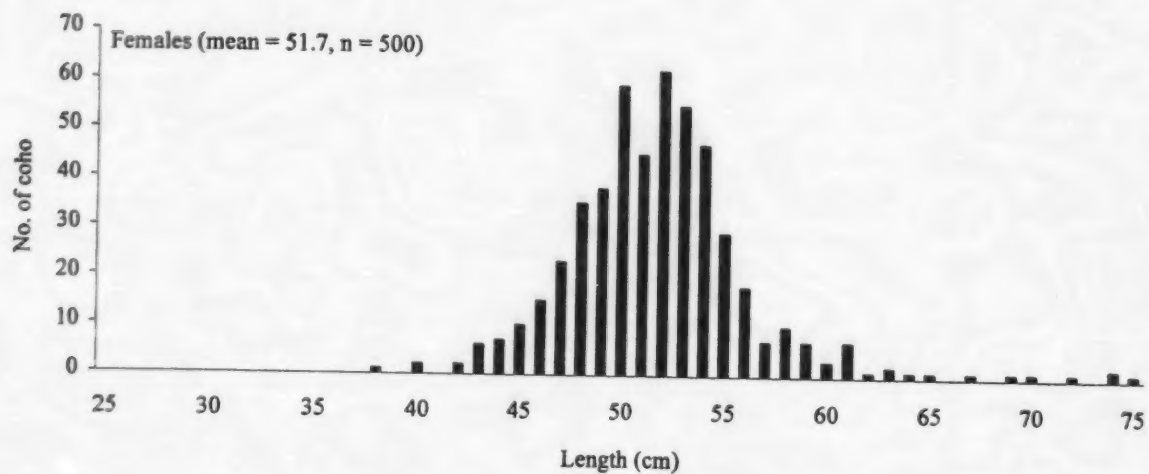
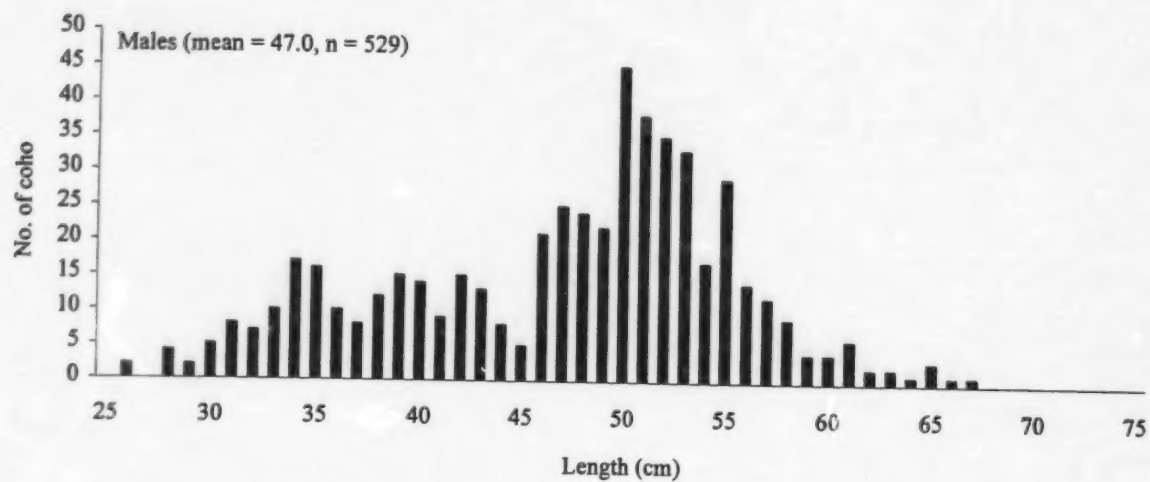


Figure 7. Length-frequency distribution of coho, by sex, Zolzap Creek, 1996.

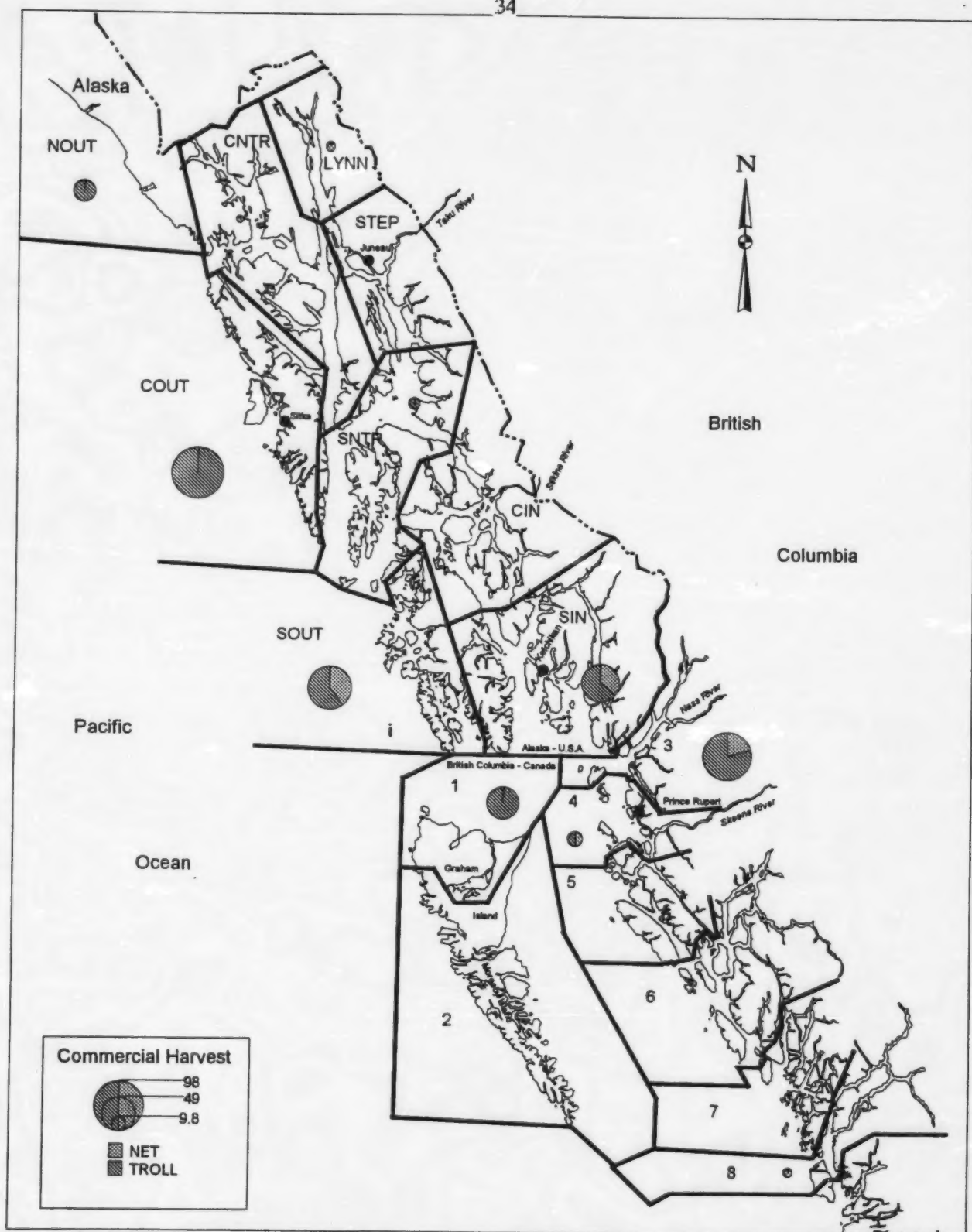


Figure 8. Fisheries Statistical Areas for the north coast of British Columbia and southeast Alaska, and commercial harvest distribution of Zolzap Creek CWT coho, 1996.

APPENDICES

Table A-1. Juvenile coho catch at Zolzap Creek, 1996.

Date	Fence		Rotary		Total	
	fry/presmolts	smolt	fry/presmolts	smolt	fry/presmolts	smolt
3-Apr			1	2	1	2
4-Apr			2	0	2	0
5-Apr			0	2	0	2
6-Apr			0	0	0	0
7-Apr			0	1	0	1
8-Apr			1	2	1	2
9-Apr			0	0	0	0
10-Apr			0	2	0	2
11-Apr			0	2	0	2
12-Apr			0	2	0	2
13-Apr			0	1	0	1
14-Apr			0	1	0	1
15-Apr			0	0	0	0
16-Apr	0	7	0	1	0	8
17-Apr	1	21	0	1	1	22
18-Apr	0	28	0	1	0	29
19-Apr	8	106	0	0	8	106
20-Apr	2	37	0	1	2	38
21-Apr	0	20	0	0	0	20
22-Apr	1	15	0	0	1	15
23-Apr	4	21	0	1	4	22
24-Apr	0	21	0	0	0	21
25-Apr	0	28	0	1	0	29
26-Apr	2	42	0	3	2	45
27-Apr	1	37	0	0	1	37
28-Apr	3	11	0	2	3	13
29-Apr	2	21	1	1	3	22
30-Apr	2	21	0	0	2	21
1-May	0	18	1	1	1	19
2-May	1	33	0	7	1	40
3-May	0	44	0	1	0	45
4-May	1	66	0	10	1	76
5-May	2	65	0	7	2	72
6-May	3	101	0	12	3	113
7-May	4	162	0	11	4	173
8-May	4	198	0	13	4	211
9-May	3	190	0	14	3	204
10-May	2	280	0	17	2	297
11-May	1	266	0	9	1	275
12-May	8	490	0	21	8	511
13-May	6	99	0	2	6	101
14-May	8	726	0	125	8	851
15-May	11	720	0	69	11	789

Table A-1. Juvenile coho catch at Zolzap Creek, 1996.

Date	Fence		Rotary		Total	
	fry/presmolts	smolt	fry/presmolts	smolt	fry/presmolts	smolt
16-May	6	1101	0	77	6	1178
17-May	5	503	0	31	5	534
18-May	11	509	1	46	12	555
19-May	6	530	0	25	6	555
20-May	10	1090	0	22	10	1112
21-May	19	1384	0	159	19	1543
22-May	36	439	0	288	36	727
23-May	28	887	3	367	31	1254
24-May	6	1908	0	237	6	2145
25-May	6	256	15	4	21	260
26-May	24	938	7	31	31	969
27-May	0	46	4	22	4	68
28-May	21	428	2	76	23	504
29-May	12	1002	7	37	19	1039
30-May	29	553	2	27	31	580
31-May	13	609	9	103	22	712
1-Jun	11	314	31	31	42	345
2-Jun	6	571	9	0	15	571
3-Jun	1	485	9	13	10	498
4-Jun	0	400	16	15	16	415
5-Jun	0	10	7	10	7	20
6-Jun	0	10	3	4	3	14
7-Jun	0	0	14	3	14	3
8-Jun	0	0	13	1	13	1
9-Jun	0	11	10	3	10	14
10-Jun	3	109	12	3	15	112
11-Jun	32	398	24	15	56	413
12-Jun	11	158	15	14	26	172
13-Jun	66	584	5	35	71	619
14-Jun	36	199	93	16	129	215
15-Jun	25	266	10	10	35	276
16-Jun	24	125	7	0	31	125
17-Jun	30	97	20	2	50	99
18-Jun	16	73	52	5	68	78
19-Jun	53	57	21	6	74	63
20-Jun	64	133	14	16	78	149
21-Jun	12	20	28	22	40	42
22-Jun	18	13	0	0	18	13
23-Jun						
24-Jun	2	0	19	1	21	1
Total	722	20,110	488	2,123	1,210	22,233

Table B-1. Non-coho catch at Zolzap Creek juvenile enumeration fence, 1996. Rotary trap catch is included.

Date	Steelhead		Cutthroat		Dolly V.		Sockeye		Lamprey		Cottid	Stickle-back
	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult		
3-Apr	0	0	0	0	0	0	0	0	0	0	0	0
4-Apr	0	0	0	0	0	0	0	0	0	0	0	0
5-Apr	0	0	0	0	0	0	0	0	0	0	0	0
6-Apr	0	0	0	0	1	0	0	0	0	0	0	0
7-Apr	0	0	1	0	0	0	0	0	0	0	0	0
8-Apr	0	0	0	0	0	0	0	0	0	0	0	0
9-Apr	0	0	0	0	0	0	0	0	0	2	0	0
10-Apr	0	0	0	0	0	0	0	0	0	0	0	0
11-Apr	0	0	0	0	1	0	0	0	0	0	0	0
12-Apr	0	0	0	0	0	0	0	0	0	0	0	0
13-Apr	0	0	0	0	1	0	0	0	0	1	0	0
14-Apr	0	0	0	0	0	0	0	0	0	0	0	0
15-Apr	0	0	0	0	0	0	0	0	0	1	0	0
16-Apr	0	0	0	0	0	0	0	0	0	0	0	0
17-Apr	0	0	0	0	1	0	0	1	0	7	5	4
18-Apr	0	0	1	5	6	0	1	0	3	20	13	0
19-Apr	0	0	1	6	4	1	0	1	0	28	5	0
20-Apr	0	0	3	1	4	0	0	1	2	18	4	1
21-Apr	0	0	2	4	6	0	0	4	1	14	10	3
22-Apr	0	0	0	4	7	1	0	0	0	13	12	4
23-Apr	0	0	1	4	6	1	0	1	2	14	3	3
24-Apr	0	0	1	4	10	0	0	1	0	10	2	1
25-Apr	0	0	2	0	3	1	0	0	2	4	12	1
26-Apr	0	0	0	2	1	1	0	0	0	7	1	2
27-Apr	0	0	0	0	2	5	0	0	3	6	1	0
28-Apr	0	0	0	0	8	0	0	0	0	25	0	5
29-Apr	1	0	0	1	4	0	0	1	2	19	5	2
30-Apr	0	0	0	0	9	0	0	0	2	15	3	4
1-May	0	0	1	1	2	2	0	0	0	6	9	2
			2	0	4	6	0	1	2	6	3	1

Table B-1. Non-coho catch at Zolzap Creek juvenile enumeration fence, 1996. Rotary trap catch is included.

Date	Steelhead		Cutthroat		Dolly V.		Sockeye		Lamprey		Cottid	Stickle-back
	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Larvae		
2-May	1	0	1	0	11	2	0	0	3	10	8	2
3-May	0	0	1	2	17	0	0	0	0	3	3	7
4-May	0	0	0	0	12	2	0	0	1	17	12	6
5-May	5	0	2	0	7	0	1	0	2	8	5	2
6-May	0	0	3	4	13	2	3	0	0	30	7	2
7-May	0	0	0	0	25	0	1	0	2	16	2	3
8-May	0	0	1	2	12	0	0	0	0	16	6	8
9-May	0	0	1	2	35	1	0	0	2	13	2	8
10-May	0	0	1	1	23	0	0	1	3	21	2	5
11-May	0	0	5	6	16	0	0	0	3	23	13	3
12-May	0	0	3	3	41	3	0	2	10	38	8	7
13-May	0	0	0	0	26	0	0	0	6	33	2	4
14-May	0	0	5	0	31	1	1	0	4	45	14	4
15-May	1	0	4	1	29	1	0	0	2	33	5	10
16-May	1	0	3	0	43	1	0	0	1	35	7	5
17-May	1	0	0	0	23	0	0	0	1	16	4	5
18-May	1	0	2	1	28	0	0	0	5	6	2	6
19-May	0	0	2	1	19	2	0	0	3	35	6	5
20-May	1	0	18	0	25	1	0	1	7	55	6	12
21-May	4	0	8	0	37	0	0	0	3	45	2	7
22-May	0	0	5	0	10	3	1	0	3	13	7	1
23-May	2	0	7	1	16	1	0	1	9	29	4	3
24-May	3	0	11	0	23	0	0	0	11	32	0	1
25-May	0	0	0	0	9	0	1	0	7	11	5	1
26-May	0	0	7	0	3	0	0	0	0	9	0	2
27-May	0	0	2	0	0	0	0	0	0	2	1	0
28-May	2	0	1	0	1	0	0	2	9	12	0	4
29-May	0	0	4	0	23	2	0	1	13	27	2	4
30-May	1	0	0	0	7	1	3	2	15	9	2	3

Table B-1. Non-coho catch at Zolzap Creek juvenile enumeration fence, 1996. Rotary trap catch is included.

Date	Steelhead		Cutthroat		Dolly V.		Sockeye		Lamprey		Cottid	Stickle-back
	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Adult	Juvenile	Larvae		
31-May	1	0	3	0	8	0	0	0	0	1	0	0
1-Jun	0	0	1	0	3	1	0	1	7	1	1	1
2-Jun	0	0	0	0	3	0	1	1	5	0	0	0
3-Jun	2	0	2	0	6	1	2	1	4	1	1	3
4-Jun	0	0	1	0	9	0	0	0	0	0	1	0
5-Jun	0	0	0	0	0	0	0	0	0	0	0	0
6-Jun	0	0	1	0	0	0	1	0	2	0	0	0
7-Jun	0	0	0	0	1	0	0	0	0	0	1	0
8-Jun	0	0	0	0	0	0	0	0	0	0	0	0
9-Jun	1	0	0	0	1	0	2	0	6	1	1	2
10-Jun	0	0	0	0	2	0	1	0	5	2	1	1
11-Jun	0	0	0	0	5	0	2	0	0	1	0	1
12-Jun	0	0	0	0	0	0	4	0	1	0	0	0
13-Jun	0	0	0	0	3	0	5	1	20	33	1	4
14-Jun	0	0	0	0	0	0	15	0	13	31	3	1
15-Jun	0	0	0	0	11	1	3	0	8	31	4	0
16-Jun	1	0	1	1	10	0	8	1	17	30	3	0
17-Jun	0	0	0	0	1	0	7	0	9	14	0	5
18-Jun	0	0	1	0	3	0	19	0	11	16	3	5
19-Jun	1	0	0	0	0	0	11	1	7	25	2	2
20-Jun	0	0	0	0	0	0	23	0	10	16	3	4
21-Jun	0	0	0	0	0	0	0	1	2	0	1	0
22-Jun	0	0	0	0	0	0	3	0	0	0	2	0
24-Jun	0	0	0	0	0	0	0	0	1	0	0	0
Total	30	0	121	55	711	44	119	28	272	1061	253	192

Table C-1. Coded-wire tagging data for coho smolts at Zolzap Creek, 1996.

Date	Total Smolts	Total Morts	Tag Code	No. AFC	Tag Morts	No. Rlsd. Untagged	No. Rlsd. AFC
3-Apr	2	0		0	0	2	0
4-Apr	0	0		0	0	0	0
5-Apr	2	0		0	0	2	0
6-Apr	0	0		0	0	0	0
7-Apr	1	0		0	0	1	0
8-Apr	2	0		0	0	2	0
9-Apr	0	0		0	0	0	0
10-Apr	2	0		0	0	2	0
11-Apr	2	0		0	0	2	0
12-Apr	2	0		0	0	2	0
13-Apr	1	0		0	0	1	0
14-Apr	1	0		0	0	1	0
15-Apr	0	0		0	0	0	0
16-Apr	8	0		0	0	8	0
17-Apr	22	2		0	0	20	0
18-Apr	29	0		0	0	29	0
19-Apr	106	1		0	0	105	0
20-Apr	38	0		0	0	38	0
21-Apr	20	0		0	0	20	0
22-Apr	15	0		0	0	15	0
23-Apr	22	0		0	0	22	0
24-Apr	21	2		0	0	19	0
25-Apr	29	2		0	0	27	0
26-Apr	45	0		0	0	45	0
27-Apr	37	0		0	0	37	0
28-Apr	13	0		0	0	13	0
29-Apr	22	0		0	0	22	0
30-Apr	21	0		0	0	21	0
1-May	19	0		0	0	19	0
2-May	40	0		0	0	40	0
3-May	45	0		0	0	45	0
4-May	76	0		0	0	76	0
5-May	72	0		0	0	72	0
6-May	113	0		0	0	0	0
7-May	173	0		0	0	0	0
8-May	211	2	18-20-52	495	34	0	461
9-May	204	0	18-20-52	203	7	1	196
10-May	297	0		0	0	0	0
11-May	275	1	18-20-52	566	5	5	561
12-May	511	1		0	0	1	0
13-May	101	0	18-20-52	609	6	1	603
14-May	851	1	18-20-52	847	6	3	841
15-May	789	0	18-20-52	786	7	3	779
16-May	1178	15	18-20-52	1150	13	13	1137
17-May	534	0	18-20-52	526	10	8	516
18-May	555	0	18-20-52	547	6	8	541
19-May	555	0	18-20-52	552	8	3	544

Table C-1. Coded-wire tagging data for coho smolts at Zolzap Creek, 1996.

Date	Total Smolts	Total Morts	Tag Code	No. AFC	Tag Morts	No. Rlsd. Untagged	No. Rlsd. AFC
20-May	1112	3	18-20-52	1088	9	21	1079
21-May	1543	0	18-20-52	1519	4	24	1515
22-May	727	66	18-20-52	652	6	9	646
23-May	1254	2	18-20-52	1239	12	13	1227
Subtotal	11,698	98	18-20-52	10,779	133	821	10,646
24-May	2145	0	18-20-53	2124	6	21	2118
25-May	260	0	18-20-53	260	4	0	256
26-May	969	0	18-20-53	959	6	10	953
27-May	68	0		0	0	0	0
28-May	504	1	18-20-53	569	3	2	566
29-May	1039	0	18-20-53	1032	7	7	1025
30-May	580	0	18-20-53	577	3	3	574
31-May	712	1	18-20-53	703	5	8	698
1-Jun	345	0	18-20-53	345	1	0	344
2-Jun	571	1	18-20-53	567	5	3	562
3-Jun	498	0	18-20-53	494	2	4	492
4-Jun	415	0	18-20-53	415	4	0	411
5-Jun	20	0		0	0	20	0
6-Jun	14	0		0	0	14	0
7-Jun	3	0		0	0	3	0
8-Jun	1	0		0	0	1	0
9-Jun	14	0		0	0	14	0
10-Jun	112	3		0	0	0	0
11-Jun	413	0	18-20-53	516	3	6	513
12-Jun	172	0		0	0	0	0
13-Jun	619	0	18-20-53	786	6	5	780
14-Jun	215	14	18-20-53	200	4	1	196
15-Jun	276	0		0	0	0	0
16-Jun	125	0		0	0	0	0
17-Jun	99	0	18-20-53	500	9	0	491
18-Jun	78	1		0	0	77	0
19-Jun	63	0		0	0	63	0
20-Jun	149	22		0	0	127	0
21-Jun	42	1		0	0	41	0
22-Jun	13	0		0	0	13	0
24-Jun	1	0		0	0	1	0
Subtotal	10,535	44	18-20-53	10,047	68	444	9,979
Total	22,233	142	all codes	20,826	201	1,265	20,625

Table D-1. Daily counts of adult coho at Zolzap Creek
enumeration fence, 1996

Date	No. examined	No. operculum tagged
31-Aug	0	0
1-Sep	0	0
2-Sep	2	0
3-Sep	0	0
4-Sep	0	0
5-Sep	0	0
6-Sep	0	0
7-Sep	12	12
8-Sep	0	0
9-Sep	0	0
10-Sep	0	0
11-Sep	0	0
12-Sep	1	1
13-Sep	0	0
14-Sep	0	0
15-Sep	0	0
16-Sep	0	0
17-Sep	0	0
18-Sep	0	0
19-Sep	0	0
20-Sep	0	0
21-Sep	0	0
22-Sep	0	0
23-Sep	0	0
24-Sep	0	0
25-Sep	0	0
26-Sep	11	9
27-Sep	60	55
28-Sep	49	47
29-Sep	3	3
30-Sep	1	1
1-Oct	2	2
2-Oct	2	2
3-Oct	0	0
4-Oct	0	0
5-Oct	0	0
6-Oct	1	1
7-Oct	0	0
8-Oct	188	177
9-Oct	383	375
10-Oct	212	211
11-Oct	58	57
12-Oct	3	3



Table D-1. Daily counts of adult coho at Zolzap Creek
enumeration fence, 1996

Date	No. examined	No. operculum tagged
31-Aug	0	0
1-Sep	0	0
2-Sep	2	0
3-Sep	0	0
4-Sep	0	0
5-Sep	0	0
6-Sep	0	0
7-Sep	12	12
8-Sep	0	0
9-Sep	0	0
10-Sep	0	0
11-Sep	0	0
12-Sep	1	1
13-Sep	0	0
14-Sep	0	0
15-Sep	0	0
16-Sep	0	0
17-Sep	0	0
18-Sep	0	0
19-Sep	0	0
20-Sep	0	0
21-Sep	0	0
22-Sep	0	0
23-Sep	0	0
24-Sep	0	0
25-Sep	0	0
26-Sep	11	9
27-Sep	60	55
28-Sep	49	47
29-Sep	3	3
30-Sep	1	1
1-Oct	2	2
2-Oct	2	2
3-Oct	0	0
4-Oct	0	0
5-Oct	0	0
6-Oct	1	1
7-Oct	0	0
8-Oct	188	177
9-Oct	383	375
10-Oct	212	211
11-Oct	58	57
12-Oct	3	3

Table D-1. Daily counts of adult coho at Zolzap Creek
enumeration fence, 1996

Date	No. examined	No. operculum tagged
13-Oct	3	3
14-Oct	0	0
15-Oct	0	0
16-Oct	0	0
17-Oct	0	0
18-Oct	0	0
19-Oct	0	0
20-Oct	0	0
21-Oct	25	25
22-Oct	11	11
23-Oct	1	1
24-Oct	0	0
25-Oct	1	1
26-Oct	0	0
27-Oct	0	0
28-Oct	6	6
29-Oct	0	0
30-Oct	0	0
31-Oct	0	0
1-Nov	0	0
2-Nov	0	0
3-Nov	0	0
4-Nov	0	0
5-Nov	0	0
6-Nov	0	0
7-Nov	0	0
8-Nov	0	0
9-Nov	0	0
10-Nov	4	4
11-Nov	0	0
12-Nov	0	0
13-Nov	0	0
14-Nov	0	0
15-Nov	0	0
16-Nov	0	0
Total	1,039	1,007



Table D-1. Daily counts of adult coho at Zolzap Creek
enumeration fence, 1996

Date	No. examined	No. operculum tagged
13-Oct	3	3
14-Oct	0	0
15-Oct	0	0
16-Oct	0	0
17-Oct	0	0
18-Oct	0	0
19-Oct	0	0
20-Oct	0	0
21-Oct	25	25
22-Oct	11	11
23-Oct	1	1
24-Oct	0	0
25-Oct	1	1
26-Oct	0	0
27-Oct	0	0
28-Oct	6	6
29-Oct	0	0
30-Oct	0	0
31-Oct	0	0
1-Nov	0	0
2-Nov	0	0
3-Nov	0	0
4-Nov	0	0
5-Nov	0	0
6-Nov	0	0
7-Nov	0	0
8-Nov	0	0
9-Nov	0	0
10-Nov	4	4
11-Nov	0	0
12-Nov	0	0
13-Nov	0	0
14-Nov	0	0
15-Nov	0	0
16-Nov	0	0
Total	1,039	1,007